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Title of the invention: Electronic eyeglass
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Specification

Title

Electronic eyeglass

Claims

1) An electronic eyeglass characterized in that refractive index of its near vision part can be controlled electronically.

2) An electronic eyeglass equipped with a near vision part with an electronically controllable refractive index characterized in that refractive index of its intermediate vision part can be controlled electronically.

Detailed description of the invention

The present invention relates to an electronic eyeglass for presbyopia, more specifically, one that allows its refractive indices for near vision and intermediate vision can be electrically controlled.

Presbyopia is a condition where a person's range of vision has reduced as the adjusting capability of the ciliary muscle through extension and contraction has degraded with age. More specifically, when a person becomes 40 years or older, the eye adjusting

capability starts to degrade and the person begins to have a difficulty in focusing first on objects closer to the eyes and then on objects at intermediate distances.

In order to compensate for the degradation of this adjusting capability and thus to recover the sight, so-called far-sighted eyeglasses are often used. Far-sighted eyeglasses include those with single focal lenses, bifocal lenses, triple-focal lenses, progressive multi-focal lenses, etc.

An eyeglass with single focal lenses is good for seeing objects close to the eyes but cannot be used for seeing objects in far distances as the vision becomes blurred when they are viewed through it. For example, if such a glass is used while the person is walking, the visions of things near the floor not only look blurred but also distorted. It is dangerous to wear such a glass when going up or down stairs.

Although a bifocal eyeglass has lenses consisting of two parts, i.e., a far vision part and a near vision part, to be worn all the time, it has drawbacks that the dividing line of the lens is conspicuous, that an image jump between the two parts is inevitable, and that the visions of things near the floor not only look blurred but also distorted when the person is walking.

A triple-focal eyeglass is designed for people who have lost their eye adjusting capabilities almost entirely and its lens is essentially equal to a bifocal lens except that it is added with a intermediate vision part to make it easier for the wearer to see things at intermediate distances, so that it has the same shortcomings as a bifocal eyeglass.

On a progressive multi-focal eyeglass, the far vision part blends in with the near vision part gradually so that there is no problem of a conspicuous boundary, but there are other shortcomings such as narrow fields of vision on both the far vision and the near vision are narrow, large optical aberration, and substantial image fluctuations.

As can be seen from the above, it is impossible to make a perfect eyeglass for presbyopia with a single fixed lens as every part of a lens has a probability of being used in near vision, intermediate vision or far vision and each part of the lens corresponds with the probability of being used for a certain view.

The object of the present invention is to eliminate the shortcomings of the prior art by means of electrically controlling the refractive index.

As is well known, the development of non-linear optical devices in recent years has been phenomenal. Many devices using solid materials and semiconductors whose refractive indices can be controlled electrically have been developed.

However, the electrical control for the focal points of eyeglasses are essentially different from those used in auto-focusing lenses of still cameras or 8 mm cinema cameras. In case of auto-focusing mechanism of cameras and the like, automatic focusing can be achieved by increasing or decreasing the refractive index of the entire lens, but it often happens in case of an eyeglass for presbyopia that a concave lens is used for compensating the vision for seeing things far off and a convex lens is used for compensating the vision for seeing things near, or a lens with non-dioptric lens is used for seeing things far off and a convex lens is used for compensating the vision for seeing things near, so that adjusting the refractive index of the entire lens used for far vision (seeing things far off) does not make a lens for near vision (seeing things near).

Therefore, it is indispensable to provide a small lens whose refractive index can be electrically controlled for near to intermediate distance visions in addition to a main lens.

The feature of this invention is in electrically controlling the refractive index of a portion of the eyeglass.

Fig. 1 (a) and (b) show an example of a lens of an electronic eyeglass according to the present invention. The drawings show lenses 1 and 2, a junction surface 3, and a small lens 4. The shape of small lens 4 can be circular, semi-circular, elliptical, rectangular, polygonal, a combination of straight lines and curves, etc. Its surface curve can be a spherical surface, ellipsoid of revolution, n-th order of surface of revolution, etc. The surfaces of lenses 1 and 2 that are in contact with lens 4 are coated with transparent electrodes. They must be isolated from each other and are attached with transparent lead wires 5 and 6. The lead wires can be extended in arbitrary directions, but must be connected to a power source that provides a voltage and a current to the small lens to control its refractive index. Cavity 4 is filled with liquid crystal, and the electrode should preferably be orientation treated.

Cavity 4 is filled with, for example, para-azoxyanisole (PAA). The refractive index in the optical axis direction $n_{[illeg.]} = 1.85$, and the refractive index in a direction

perpendicular to the optical axis $n_o = 1.56$, so that the refractive index can change $n_{[illeg.]} - n_o = 0.29$ when a voltage is applied to the small lens. The refractive index can be changed to any value between those two values continuously by adjusting the voltage.

Let us discuss now about the dimensions and the degree of addition of the small lens. The degree of addition D_{add} for a thin lens can be expressed as follows:

$$D_{add} = (n_2 - n_1)(1/r_1 - 2/r_2)$$

n_1: refractive index of the main lens

n_2: refractive index of the small lens

r_1: radius of curvature of the front face of the small lens

r_2: radius of curvature of the back face of the small lens

Let the diameter of the small lens be 10 mm, $n_2 - n_1 = 0.2$, and $r_2 = \infty$, then the relation between r_1 and the center thickness of the small lens is as shown in Table 1. As the degree of addition becomes larger, the center thickness increases, decreasing the transparency of the liquid crystal, and increasing the required drive voltage, but it is still within the limit of practical use until the center thickness reaches approximately 0.25 mm.

Table 1

Degree of addition, D	r_1, mm	Center thickness, mm
1.00	200	0.06
2.00	100	0.13
4.00	50	0.25

Next, the process of preparing the intermediate vision part will be described. The degree of addition for the intermediate vision can be smaller than for the near vision. Therefore, the radius of curvature of the small lens for the intermediate vision is selected larger than that for the near vision. Its location relative to the small lens should be more toward the optical center of the main lens, and the intermediate vision part should be connected to the near vision part with a continuous curve in order to minimize the image jump. In a special case, even a discontinuation such as in a triple-focal lens may be allowed.

It is ideal to have a uniform refractive index, so that it is arranged so by adjusting the composition of the main lens and the small lens. For example, a main lens with a

refractive index of 1.52 can be obtained by composing the main lens with acrylic and styrene resins.

The electric control for switching the refractive index can be accomplished either by the eyeglass user's pressing of a pushbutton or touching of a touch switch, or by means of a signal from a detector that detects the distance automatically, among others, but it should be noted that the invention is not limited by these modes of switching.

A silver battery, a lithium battery, air battery, etc., can be suitably used as the power source. Since the eyeglass is typically used in an area with sufficient light, the size of the battery can be reduced by using a solar battery combined with a secondary battery of either a silver battery, lithium battery, air battery, Ni-Cd battery, Ni-Zn battery, Ni-Fe battery, etc.

Forming such an electronic lens to fit a frame constitutes an electronic eyeglass according to the present invention.

An electronic eyeglass according to the present invention allows the user to use the near vision, intermediate vision and far vision parts of the eyeglass in a timesharing manner and eliminates the shortcomings of the prior art, e.g., aberrations, fluctuations of images, conspicuous boundaries between various parts of an eyeglass, etc., thus providing great advantages in practical uses.

Brief descriptions of the drawings

Fig. 1 (a) and (b) show an example of eyeglasses according to the present invention, where label 4 denotes the "near part (small lens)."

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Fig. 1

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⑭電子メガネ

㉑特　　願　昭53—149497
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明　　細　　書

発明の名称

電　子　メ　ガ　ネ

特許請求の範囲

1) 近用部の屈折率が電気的に増減することを特徴とする電子メガネ。

2) 近用部の屈折率が電気的に増減するメガネにおいて、中間用部の屈折率を電気的に増減することを特徴とする電子メガネ。

発明の詳細な説明

本発明は、老視用電子メガネに係わるものであり、詳しくは近用部、中間用部の屈折率が電気的に増減することを特徴とする。

老視とは、毛様筋の緊張、弛緩による調節力が衰退したため、見える範囲が限定されることをいう。具体的には、人間は40才以上になると眼の調節力が小さくなり、近部つづいて中間部は焦点が合わなくなる。

この調節力の衰退を補い、視力を回復させるために通称老眼鏡がある。老眼鏡には単焦点レンズ、二重焦点レンズ、三重焦点レンズおよび累進多焦点レンズ等がある。

単焦点レンズ老眼鏡は、近用の仕事をする時には極めて都合が良いが、遠くを見ると対象が惚けて良く見えない。歩行時に掛けると足元が惚けるとともに歪んで見える。特に階段の昇降時には、足元が危く危険である。

二重焦点レンズ老眼鏡は、レンズを遠用部と近用部に分け、常時携帯できるように作られてはいるが、近用部の境界が目立つことと、像のジャンプが避けられないことと、近用部で足元を見ると惚けるとともに歪むこと等の欠点を有している。

三重焦点レンズ老眼鏡は、眼の調節力がほとんどなくなつた人用のもので、中間部が良く見えるよう二重焦点レンズに中間用を加えたものであり、基本的に二重焦点と同様の欠点を有している。

累進多焦点レンズ老眼鏡は、近用、中間用部の境界が連続的につながつており、像のジャンプ・

親玉と小玉の屈折率は、遠くを見る時同一であることが理想的で、親玉の組成と小玉の組成をそれぞれ調節することにより同一にする。例えば、屈折率が1.52の親玉はアクリル樹脂とスチロール樹脂とのブレンドによりできる。

小玉部の屈折率を変える電気制御は、スイッチを眼鏡携帯者が押すこと、又はタッチスイッチで静電的におこなうこと、自動距離測定ユニットからの信号によりおこなうこと等各種あるが、本発明はいずれでも良く、これによる限定されない。

電源には、銀電池、リチウム電池、空気電池等が適している。眼鏡は明るい所で使用する故、太陽電池を併用し、銀電池、リチウム電池、空気電池、ニッケル－カドミニウム電池、ニッケル－亜鉛電池、ニッケル－鉄電池等の二次電池と組合せて用いると電池を小型化できる。

このような電子レンズをフレームの形状に加工し組み込んだものが、本発明になる電子メガネである。

本発明の電子メガネは、遠用、中間用、近用を

それぞれタイムシェアリングにより使い分けたものであり、携帯時の取扱、像の揺れ、レンズの境界線の目立ち等の欠点を除去したもので、その実用価値は極めて大きい。

図面の簡単な説明

第1図(a)および(b)は本発明になる電子メガネのメガネレンズの1例であり、4が近用（小玉）部である。

以上

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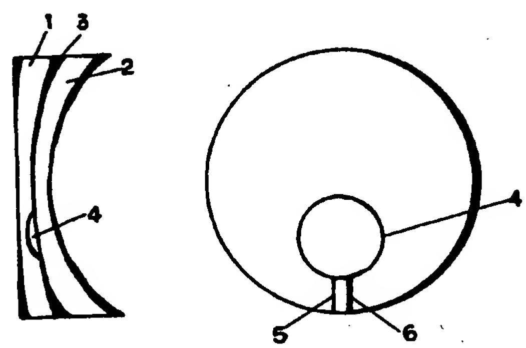

(a)　(b)

第1図

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TITLE: ELECTRONIC SPECTACLES

---------- KWIC ---------

TTL:
ELECTRONIC SPECTACLES

CCXR:
351/168

FPAR:
CONSTITUTION: A small ball which is capable of controlling refractive indices is inserted in the near-vision part and intermediate-vision part of a spectacle lens. Namely, the small ball is inserted at the faying surface 3 of lenses 1, 2. The shape of the small ball for near-vision may be circle, segment, ellipse, etc. and its surface curve is preferably ellipsoid of revolution and surface of revolution of n-degrees, in order to reduce the aberrations of the lens. Transparent electrodes are coated on the lens 1 and 2 in contact with the small ball 4. These are mutually insulated and lead wires 5, 6 are led out from the respective transparent electrodes . The lead wires are connected to a power source which applies voltage and current to the small ball part and changes its refractive index. Liquid crystal is put in a cavity part 4. In this way, the refractive index may be changed continuously or stepwise.

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